CHI MEI OPTOELECTRONICS CORP.

Issued Date: 10, Aug 2007
Model No.: V260B1 - L08
Tentative

# TFT LCD Approval Specification

# MODEL NO.: V260B1 - L08

Customer : _____

Approved by : _____

Customer : _____

Approved by : _____

Note :

| | |
|---|---|
| Approved By | TV Head Division |
| | LY Chen |

| | | |
|---|---|---|
| Reviewed By | QRA Dept. | Product Development Div. |
| | Tomy Chen | WT Lin |

| | | |
|---|---|---|
| Prepared By | LCD TV Marketing and Product Management Div. | |
| | Denise Shieh | Delia Lin |



Version 0.0

# CONTENTS -

## REVISION HISTORY

| Version | Date | Page (New) | Section | Description |
|---|---|---|---|---|
| Ver 0.0 | 10, Aug '07 | All | All | Tentative Specification was first issued. |

# 1. GENERAL DESCRIPTION

## 1.1 OVERVIEW

V260B1- L08 is a TFT Liquid Crystal Display module with 12-CCFL Backlight unit and 1ch-LVDS interface. The display diagonal is 26". This module supports 1366 x 768 WXGA format and can display 16.2M colors (6-bit+FRC colors). The inverter module for backlight is built-in.

## 1.2 FEATURES

- Excellent Brightness 500nits
- Contrast Ratio 800:1
- Fast Response Time (8ms)
- Color Saturation NTSC 72%
- WXGA (1366 x 768 pixels) Resolution
- DE (Data Enable) Only Mode
- LVDS (Low Voltage Differential Signaling) Interface
- Viewing Angle: 160(H)/150(V) (CR>10) TN Technology

-Color Reproduction (Nature Color)

- RoHS Compliance

## 1.3 APPLICATION

- TFT LCD TVs
- High Brightness, Multi-Media Displays

## 1.4 GENERAL SPECIFICATI0NS

| Item | Specification | Unit | Note |
|---|---|---|---|
| Active Area | 575.769 (H) x 323.712 (V) (26" Diagonal) | mm | (1) |
| Bezel Opening Area | 580.8 (H) x 328.8 (V) | mm | |
| Driver Element | a-si TFT Active Matrix | — | |
| Pixel Number | 1366 x R.G.B. x 768 | pixel | |
| Pixel Pitch (Sub Pixel) | 0.1405 (H) x 0.4215 (V) | mm | |
| Pixel Arrangement | RGB Vertical Stripe | — | |
| Display Colors | 16.2M | color | |
| Display Operation Mode | Transmissive Mode / Normally White | — | |
| Surface Treatment | Anti-Glare Coating (Haze 25%)<br>Hard Coating (3H) | — | |

## 1.5 MECHANICAL SPECIFICATIONS

| Item | | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Module Size | Horizontal(H) | 625 | 626 | 627 | mm | |
| | Vertical(V) | 372 | 373 | 374 | mm | |
| | Depth(D) | 35.6 | 36.6 | 37.6 | mm | To PCB Cover |
| | Depth(D) | 42.6 | 43.6 | 44.6 | mm | To Inverter Cover |
| Weight | | — | 4500 | — | g | |

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

## 2. ABSOLUTE MAXIMUM RATINGS

### 2.1 ABSOLUTE RATINGS OF ENVIRONMENT

| Item | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Storage Temperature | $T_{ST}$ | -20 | +60 | ºC | (1) |
| Operating Ambient Temperature | $T_{OP}$ | 0 | +50 | ºC | (1), (2) |
| Shock (Non-Operating) | $S_{NOP}$ | — | 50 | G | (3), (5) |
| Vibration (Non-Operating) | $V_{NOP}$ | — | 1.0 | G | (4), (5) |

Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. (Ta ≦ 40 ºC).

(b) Wet-bulb temperature should be 39 ºC Max. (Ta > 40 ºC).

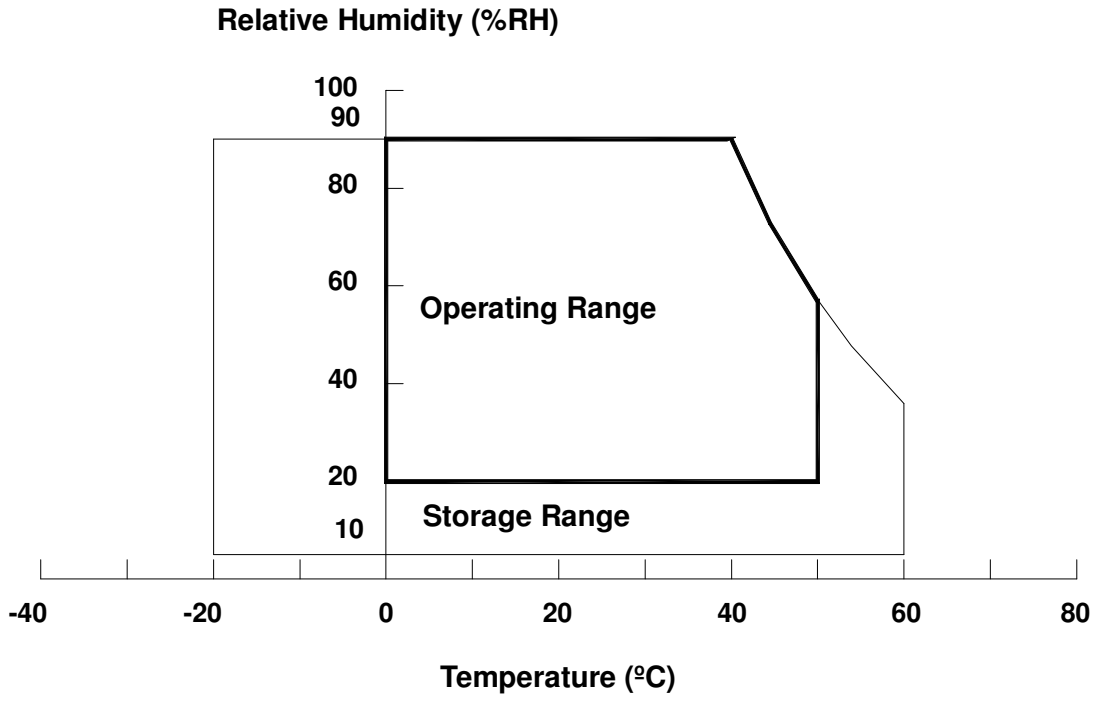
(c) No condensation.

Note (2) The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 60 ºC with LCD module alone in a temperature controlled chamber. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 60 ºC. The range of operating temperature may degrade in case of improper thermal management in final product design.

Note (3) 11 ms, half sine wave, 1 time for ± X, ± Y, ± Z.

Note (4) 10 ~ 500 Hz, 10 min, 1 time each X, Y, Z.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.



## 2.2 ELECTRICAL ABSOLUTE RATINGS

### 2.2.1 TFT LCD MODULE

| Item | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Power Supply Voltage | Vcc | -0.3 | 13.0 | V | (1) |
| Input Signal Voltage | $V_{IN}$ | -0.3 | 3.6 | V | |

### 2.2.2 BACKLIGHT UNIT

| Item | Symbol | Test Condition | Min. | Type | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Lamp Voltage | $V_W$ | Ta = 25 ℃ | — | — | 3000 | $V_{RMS}$ | |
| Power Supply Voltage | $V_{BL}$ | — | 0 | — | 30 | V | (1) |
| Control Signal Level | — | — | -0.3 | — | 7 | V | (1), (3) |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Functional operation should be restricted to the conditions described under normal operating conditions.

Note (2) No moisture condensation or freezing.

Note (3) The control signals includes Backlight On/Off Control, Internal PWM Control and External PWM Control.

## 3. ELECTRICAL CHARACTERISTICS

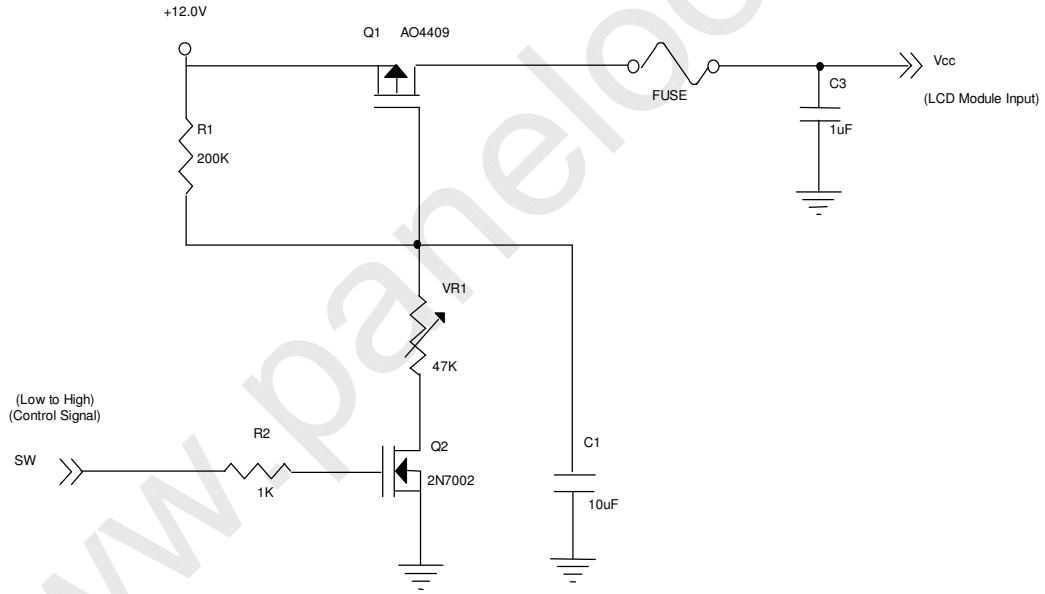
### 3.1 TFT LCD MODULE

Ta = 25 ± 2 ºC

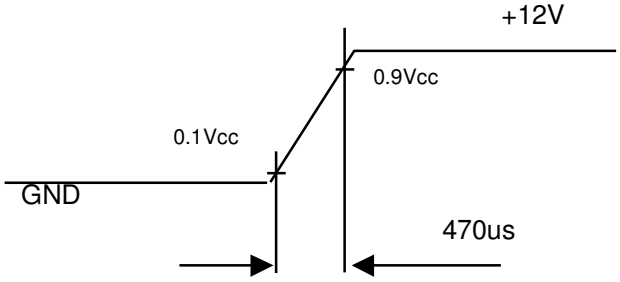
| Parameter | | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| Power Supply Voltage | | $V_{CC}$ | 11.4 | 12.0 | 12.6 | V | (1) |
| Power Supply Ripple Voltage | | $V_{RP}$ | — | — | 300 | mV | |
| Rush Current | | $I_{RUSH}$ | — | — | 3.0 | A | (2) |
| Power Supply Current | White | $I_{CC}$ | — | 0.2 | — | A | (3) |
| | Black | | — | 0.5 | — | A | |
| | Vertical Stripe | | — | 0.4 | — | A | |
| LVDS Interface | Differential Input High Threshold Voltage | $V_{LVTH}$ | — | — | +100 | mV | |
| | Differential Input Low Threshold Voltage | $V_{LVTL}$ | -100 | — | — | mV | |
| | Common Input Voltage | $V_{LVC}$ | 1.125 | 1.25 | 1.375 | V | |
| | Terminating Resistor | $R_T$ | — | 100 | — | ohm | |
| CMOS interface | Input High Threshold Voltage | $V_{IH}$ | 2.7 | — | 3.3 | V | |
| | Input Low Threshold Voltage | $V_{IL}$ | 0 | — | 0.7 | V | |

Note (1) The module should be always operated within above ranges.

Note (2) Measurement Conditions:




**Vcc rising time is 470us**



Note (3) The specified power supply current is under the conditions at Vcc = 12 V, Ta = 25 ± 2 ºC, $f_v$ = 60 Hz, whereas a power dissipation check pattern below is displayed.

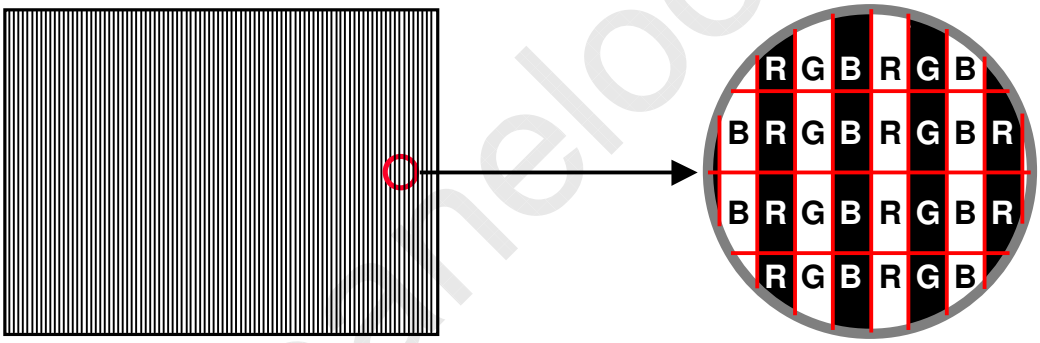
a. White Pattern

Active Area

b. Black Pattern

Active Area

c. Vertical Stripe Pattern




Active Area

### 3.2 BACKLIGHT INVERTER UNIT

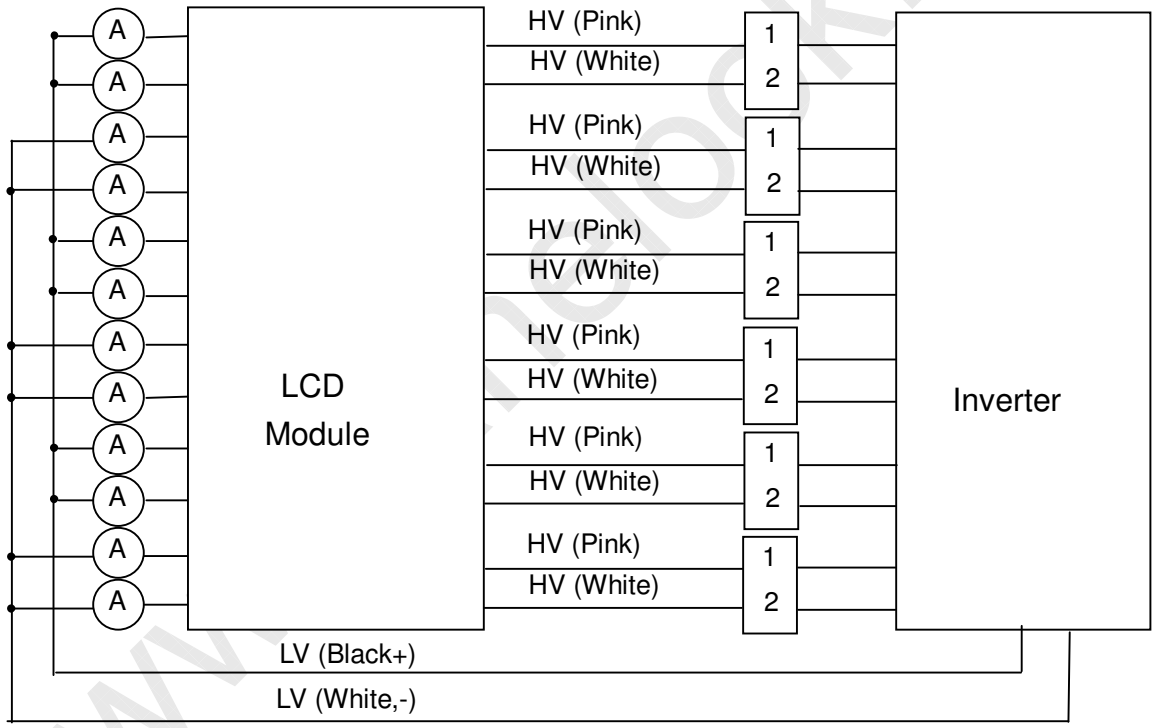
#### 3.2.1 CCFL (Cold Cathode Fluorescent Lamp) CHARACTERISTICS (Ta = 25 ± 2 ºC)

| Parameter | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Lamp Voltage | $V_W$ | — | 970 | — | $V_{RMS}$ | $I_L$ = 5.0mA |
| Lamp Current | $I_L$ | 4.5 | 5.0 | 5.5 | $mA_{RMS}$ | (1) |
| Lamp Starting Voltage | $V_S$ | — | — | 1550 | $V_{RMS}$ | (2), Ta = 0 ºC |
| | | — | — | 1400 | $V_{RMS}$ | (2), Ta = 25 ºC |
| Operating Frequency | $F_O$ | 40 | — | 80 | KHz | (3) |
| Lamp Life Time | $L_{BL}$ | 50,000 | 60,000 | — | Hrs | (4) |

### 3.2.2 INVERTER CHARACTERISTICS (Ta = 25 ± 2 ºC)

| Parameter | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Power Consumption | $P_{BL}$ | — | 66 | 69 | W | (5)(6), $I_L$ = 5.0mA |
| Input Voltage | $V_{BL}$ | 22.8 | 24 | 25.2 | $V_{DC}$ | |
| Input Current | $I_{BL}$ | — | 2.75 | — | A | Non Dimming |
| Input Inrush Current | — | — | — | 4.3 | $A_{peak}$ | $V_{BL}$ =24.0V |
| Input Ripple Noise | —- | — | — | 864 | $mV_{P-P}$ | $V_{BL}$ =22.8V |
| Oscillating Frequency | $F_W$ | 55 | 58 | 61 | kHz | |
| Dimming Frequency | $F_B$ | 150 | 160 | 170 | Hz | |
| Minimum Duty Ratio | $D_{MIN}$ | — | 20 | — | % | |

Note (1) Lamp current is measured by utilizing high frequency current meters as shown below:




Note (2) The lamp starting voltage $V_S$ should be applied to the lamp for more than 1 second under starting up duration. Otherwise the lamp could not be lighted on completed.

Note (3) The lamp frequency may produce interference with horizontal synchronous frequency from the display, and this may cause line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (4) The life time of a lamp is defined as when the brightness is larger than 50% of its original value

and the effective discharge length is longer than 80% of its original length (Effective discharge length is defined as an area that has equal to or more than 70% brightness compared to the brightness at the center point.) as the time in which it continues to operate under the condition Ta = 25 ±2℃ and $I_L$ = 4.5~ 5.5$mA_{RMS}$.

Note (5) The power supply capacity should be higher than the total inverter power consumption $P_{BL}$. Since the pulse width modulation (PWM) mode was applied for backlight dimming, the driving current changed as PWM duty on and off. The transient response of power supply should be considered for the changing loading when inverter dimming.

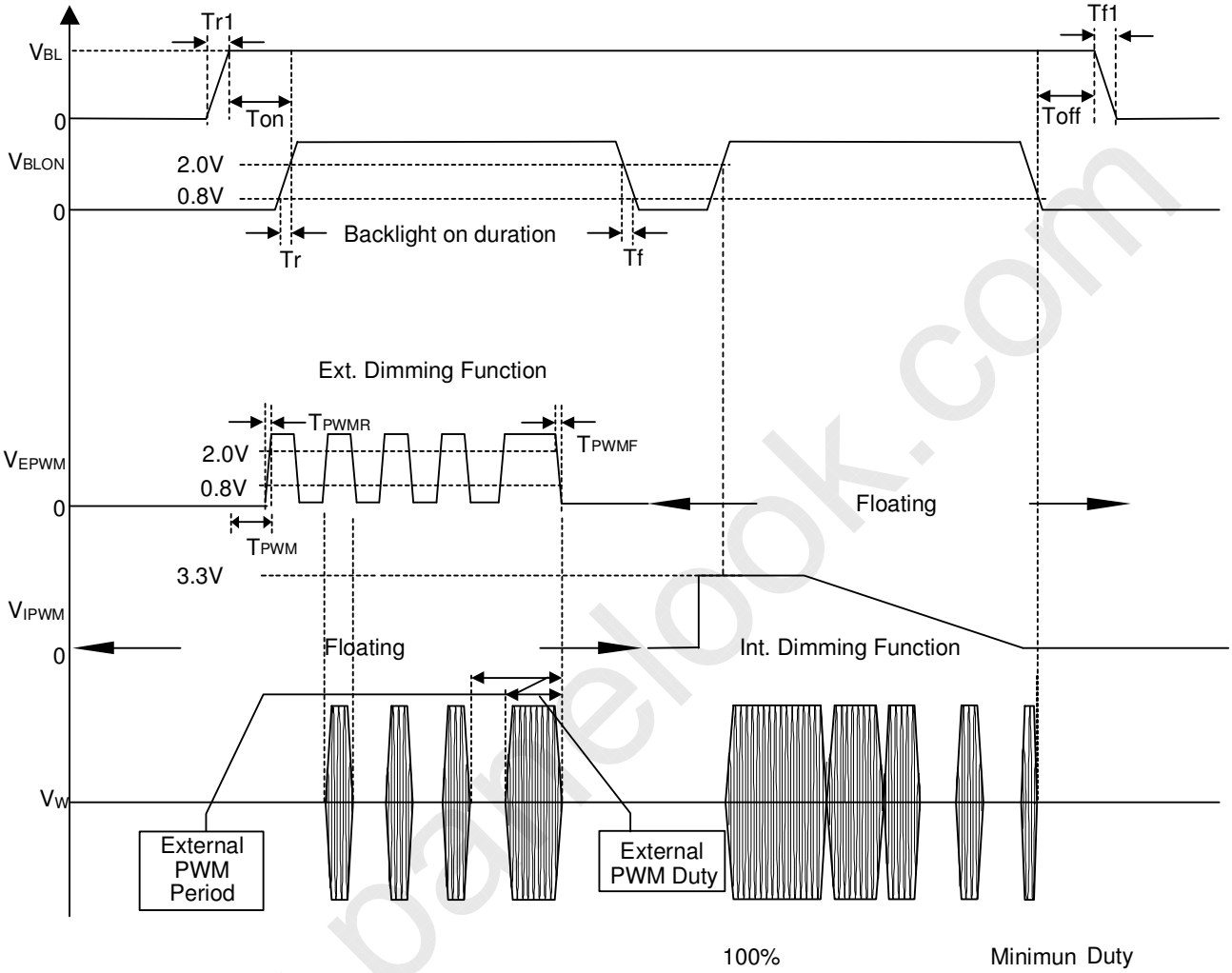
Note (6) The measurement of Max. value is based on 26" backlight unit under 24V input voltage and 5.3mA lamp in average after lighting for 30 minutes.

### 3.2.3 INVERTER INTERTFACE CHARACTERISTICS

| Item | | Symbol | Test Condition | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Error Signal | | ERR | — | — | — | — | — | (Note 1) |
| On/Off Control Voltage | ON | $V_{BLON}$ | — | 2.0 | — | 5.0 | V | |
| | OFF | | — | 0 | — | 0.8 | V | |
| Internal PWM Control Voltage | MAX | $V_{IPWM}$ | — | 3.0 | 3.15 | 3.3 | V | Maximum Duty Ratio |
| | MIN | | | — | 0 | — | V | Minimum Duty Ratio |
| External PWM Control Voltage | HI | $V_{EPWM}$ | — | 2.0 | — | 5.0 | V | Duty On |
| | LO | | | 0 | — | 0.8 | V | Duty Off |
| VBL Rising Time | | Tr1 | — | 30 | — | 50 | ms | |
| VBL Falling Time | | Tf1 | — | 30 | — | 50 | ms | |
| Control Signal Rising Time | | $T_r$ | — | — | — | 100 | ms | |
| Control Signal Falling Time | | $T_f$ | — | — | — | 100 | ms | |
| PWM Signal Rising Time | | $T_{PWMR}$ | — | — | — | 50 | us | |
| PWM Signal Falling Time | | $T_{PWMF}$ | — | — | — | 50 | us | |
| Input Impedance | | $R_{IN}$ | — | 1 | — | — | MΩ | |
| PWM Delay Time | | $T_{PWM}$ | | 100 | | 300 | ms | |
| BLON Delay Time | | $T_{on}$ | — | 300 | — | 500 | ms | |
| BLON Off Time | | $T_{off}$ | — | 300 | — | 500 | ms | |

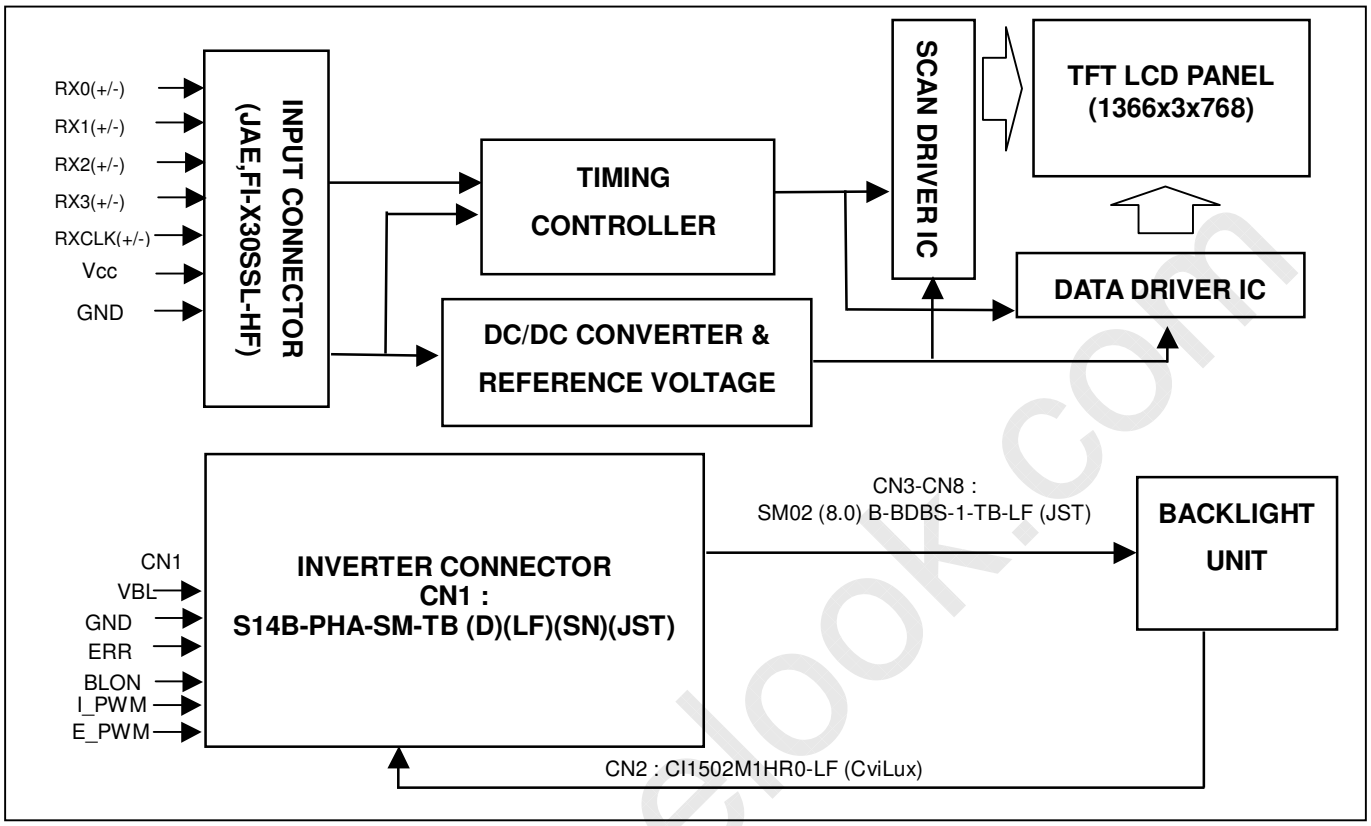
Note (1) The power sequence and control signal timing as shown in following figure.

Note (2) When inverter protective function is triggered, ERR will output open collector status. In normal operation, the signal of ERR will output a low level voltage.



# 4. BLOCK DIAGRAM

## 4.1 TFT LCD MODULE



## 5. INTERFACE PIN CONNECTION

### 5.1 TFT LCD MODULE

**CNF1 Connector Pin Assignment**

| Pin No. | Symbol | Description | Note |
|---|---|---|---|
| 1 | VCC | Power supply: +12V | |
| 2 | VCC | Power supply: +12V | |
| 3 | VCC | Power supply: +12V | |
| 4 | VCC | Power supply: +12V | |
| 5 | GND | Ground | |
| 6 | GND | Ground | |
| 7 | GND | Ground | |
| 8 | GND | Ground | |
| 9 | SELLVDS | Select LVDS data format | (2) |
| 10 | NC | No connection | (3) |
| 11 | GND | Ground | |
| 12 | RX0- | Negative transmission data of pixel 0 | |
| 13 | RX0+ | Positive transmission data of pixel 0 | |
| 14 | GND | Ground | |
| 15 | RX1- | Negative transmission data of pixel 1 | |
| 16 | RX1+ | Positive transmission data of pixel 1 | |
| 17 | GND | Ground | |
| 18 | RX2- | Negative transmission data of pixel 2 | |
| 19 | RX2+ | Positive transmission data of pixel 2 | |
| 20 | GND | Ground | |
| 21 | RXCLK- | Negative of clock | |
| 22 | RXCLK+ | Positive of clock | |
| 23 | GND | Ground | |
| 24 | RX3- | Negative transmission data of pixel 3 | |
| 25 | RX3+ | Positive transmission data of pixel 3 | |
| 26 | GND | Ground | |
| 27 | NC | No connection | (3) |
| 28 | NC | No connection | (3) |
| 29 | GND | Ground | |
| 30 | GND | Ground | |

Note (1) Connector Part No.: JAE,FI-X30SSL-HF or compatible

Note (2) Ground or OPEN: Normal, High: JEIDA LVDS format

Please refer to 5.5 LVDS INTERFACE (Page 17)

Note (3) Reserved for internal use. Please leave it open.

## 5.2 BACKLIGHT UNIT

The pin configuration for the housing and leader wire is shown in the table below.

CN3-CN8 (Housing) : BDBR-03(4.0)V-1S (JST)

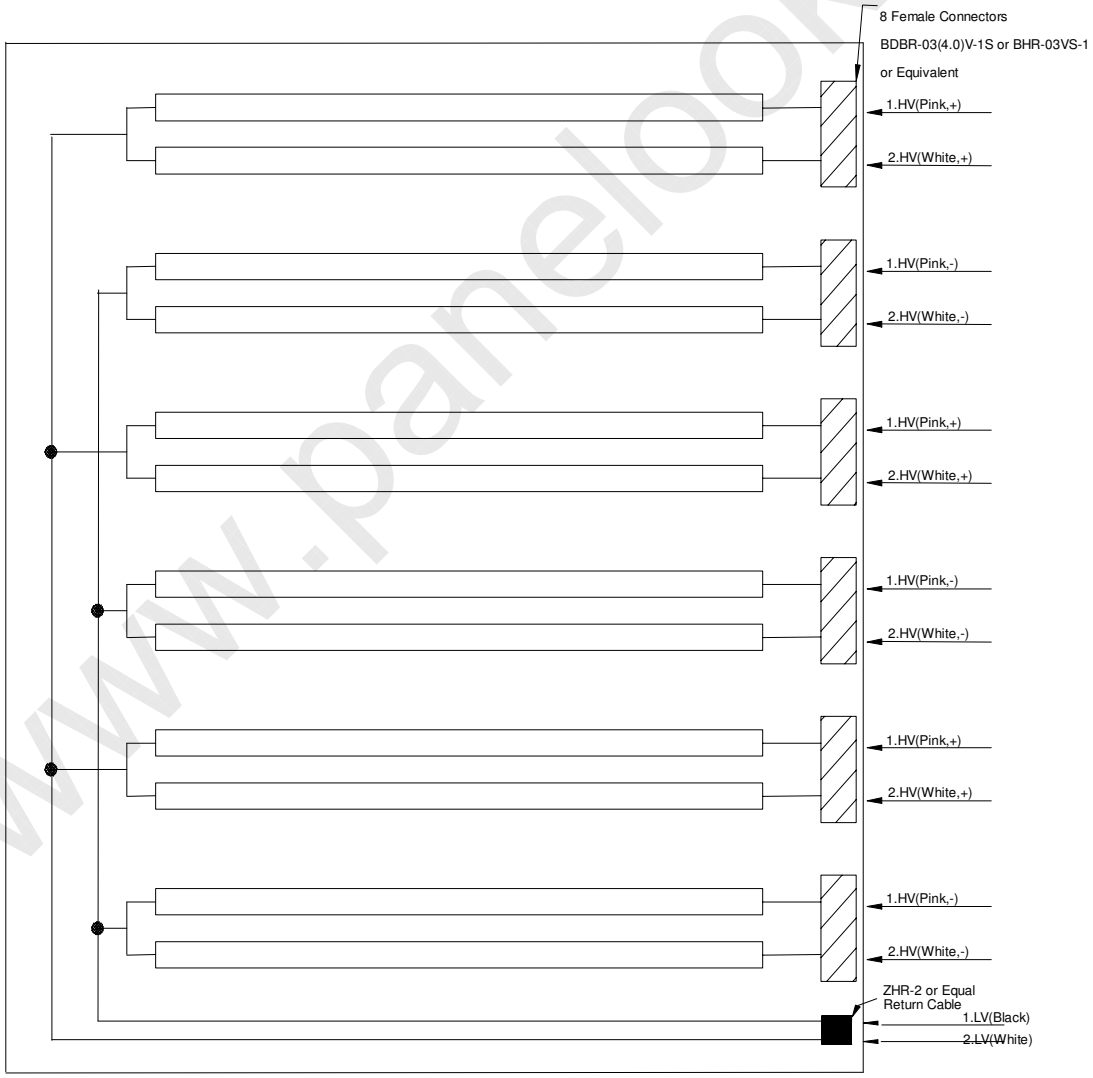
| Pin No. | Symbol | Description | Wire Color |
|---|---|---|---|
| 1 | HV | High Voltage | Pink |
| 2 | HV | High Voltage | White |

Note (1) The backlight interface housing for high voltage side is a model BDBR-03 (4.0)V-1S (JST). The mating header on inverter part number is SM 02(8.0) B-BDBS-1-TB-LF(JST).

CN2 (Housing) : CI1502S0000 (CviLux)

| Pin No. | Symbol | Description | Wire Color |
|---|---|---|---|
| 1 | LV | Low Voltage (+) | Black |
| 2 | LV | Low Voltage (-) | White |

Note (2) The backlight interface housing and return cable for low voltage side is a model CI1502S0000, manufactured by CviLux. The mating header on inverter part number is CI1502M1HR0-LF (CviLux).



### 5.3 INVERTER UNIT

CN1 (Header) : S14B -PHA-SM-TB(D)(LF)(SN)(JST)

| Pin No. | Symbol | Description |
|---|---|---|
| 1 | VBL | +24V Power input |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | GND | Ground |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | ERR | Normal (GND)<br>Abnormal(Open collector) |
| 12 | BLON | BL ON/OFF |
| 13 | I_PWM | Internal PWM Control |
| 14 | E_PWM | External PWM Control |

Notice:

#PIN 13:Analog Dimming Control (Use Pin 13) : 0V~3.3V and Pin 14 must open.

#PIN 14:PWM Dimming Control (Use Pin 14) : Pin 13 must open.

#Pin 13 (I_PWM) and Pin 14 (E_PWM) can not open in same period.

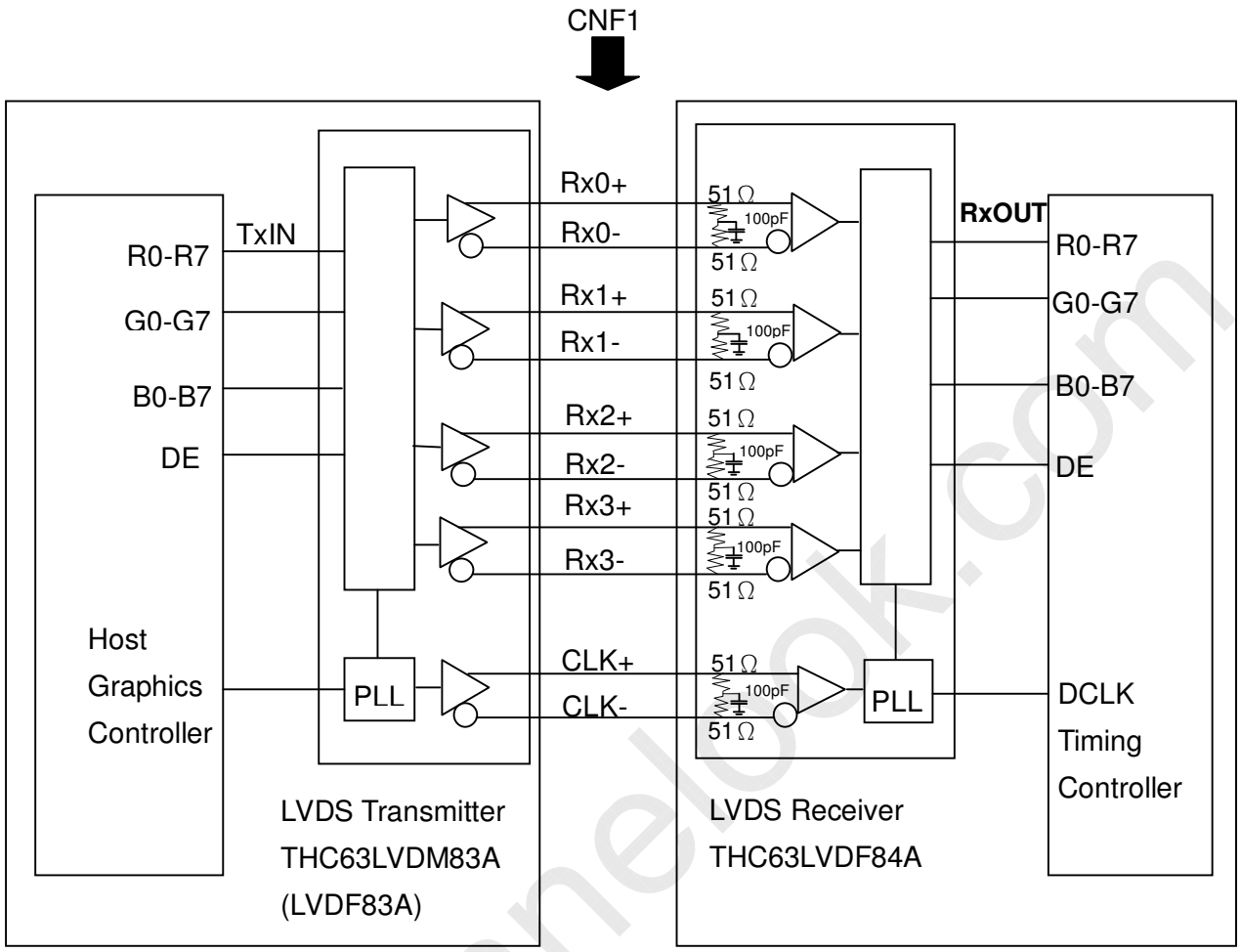
CN2 (Header) : CI1502M1HR0-LF (CviLux)

| Pin No. | Symbol | Description |
|---|---|---|
| 1 | CCFL COLD | CCFL Low Voltage (+) |
| 2 | CCFL COLD | CCFL Low Voltage (-) |

CN3-CN8 (Header) : SM02 (8.0) B-BDBS-1-TB-LF (JST)

| Pin | Name | Description |
|---|---|---|
| 1 | CCFL HOT | CCFL High Voltage |
| 2 | CCFL HOT | CCFL High Voltage |

### 5.4 BLOCK DIAGRAM OF INTERFACE




R0~R7 : Pixel R Data
G0~G7 : Pixel G Data
B0~B7 : Pixel B Data
DE : Data Enable Signal

Note (1) The system must have the transmitter to drive the module.
Note (2) LVDS cable impedance shall be 50 ohms per signal line or about 100 ohms per twist-pair line when it is used differentially.

### 5.5 LVDS INTERFACE

| | SIGNAL | | TRANSMITTER THC63LVDM83A | | INTERFACE CONNECTOR | | RECEIVER THC63LVDF84A | | TFT CONTROL INPUT | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SELLVD= L or OPEN | SELLVDS =H | PIN | INPUT | Host | TFT-LCD | PIN | OUTPUT | SELLVD= L or OPEN | SELLVDS =H |
| 24 bit | R0 | R2 | 51 | TxIN0 | | | 27 | Rx OUT0 | R0 | R2 |
| | R1 | R3 | 52 | TxIN1 | | | 29 | Rx OUT1 | R1 | R3 |
| | R2 | R4 | 54 | TxIN2 | TA OUT0+ | Rx 0+ | 30 | Rx OUT2 | R2 | R4 |
| | R3 | R5 | 55 | TxIN3 | | | 32 | Rx OUT3 | R3 | R5 |
| | R4 | R6 | 56 | TxIN4 | | | 33 | Rx OUT4 | R4 | R6 |
| | R5 | R7 | 3 | TxIN6 | TA OUT0- | Rx 0- | 35 | Rx OUT6 | R5 | R7 |
| | G0 | G2 | 4 | TxIN7 | | | 37 | Rx OUT7 | G0 | G2 |
| | G1 | G3 | 6 | TxIN8 | | | 38 | Rx OUT8 | G1 | G3 |
| | G2 | G4 | 7 | TxIN9 | | | 39 | Rx OUT9 | G2 | G4 |
| | G3 | G5 | 11 | TxIN12 | TA OUT1+ | Rx 1+ | 43 | Rx OUT12 | G3 | G5 |
| | G4 | G6 | 12 | TxIN13 | | | 45 | Rx OUT13 | G4 | G6 |
| | G5 | G7 | 14 | TxIN14 | | | 46 | Rx OUT14 | G5 | G7 |
| | B0 | B2 | 15 | TxIN15 | TA OUT1- | Rx 1- | 47 | Rx OUT15 | B0 | B2 |
| | B1 | B3 | 19 | TxIN18 | | | 51 | Rx OUT18 | B1 | B3 |
| | B2 | B4 | 20 | TxIN19 | | | 53 | Rx OUT19 | B2 | B4 |
| | B3 | B5 | 22 | TxIN20 | | | 54 | Rx OUT20 | B3 | B5 |
| | B4 | B6 | 23 | TxIN21 | TA OUT2+ | Rx 2+ | 55 | Rx OUT21 | B4 | B6 |
| | B5 | B7 | 24 | TxIN22 | | | 1 | Rx OUT22 | B5 | B7 |
| | DE | DE | 30 | TxIN26 | | | 6 | Rx OUT26 | DE | DE |
| | R6 | R0 | 50 | TxIN27 | TA OUT2- | Rx 2- | 7 | Rx OUT27 | R6 | R0 |
| | R7 | R1 | 2 | TxIN5 | | | 34 | Rx OUT5 | R7 | R1 |
| | G6 | G0 | 8 | TxIN10 | | | 41 | Rx OUT10 | G6 | G0 |
| | G7 | G1 | 10 | TxIN11 | | | 42 | Rx OUT11 | G7 | G1 |
| | B6 | B0 | 16 | TxIN16 | TA OUT3+ | Rx 3+ | 49 | Rx OUT16 | B6 | B0 |
| | B7 | B1 | 18 | TxIN17 | | | 50 | Rx OUT17 | B7 | B1 |
| | RSVD 1 | RSVD 1 | 25 | TxIN23 | | | 2 | Rx OUT23 | NC | NC |
| | RSVD 2 | RSVD 2 | 27 | TxIN24 | TA OUT3- | Rx 3- | 3 | Rx OUT24 | NC | NC |
| | RSVD 3 | RSVD 3 | 28 | TxIN25 | | | 5 | Rx OUT25 | NC | NC |
| | | DCLK | 31 | TxCLK IN | TxCLK OUT+ TxCLK OUT- | RxCLK IN+ RxCLK IN- | 26 | RxCLK OUT | DCLK | |

R0~R7: Pixel R Data (7; MSB, 0; LSB)

G0~G7: Pixel G Data (7; MSB, 0; LSB)

B0~B7: Pixel B Data (7; MSB, 0; LSB)

DE : Data enable signal

Notes(1) RSVD(reserved)pins on the transmitter shall be “H” or “L”.

### 5.6 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

| Color | | Data Signal | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Red | | | | | | | | Green | | | | | | | | Blue | | | | | | | |
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale Of Red | Red(0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(2) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Red(253) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(254) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(255) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of Green | Green(0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Green(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale Of Blue | Blue(0) / Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Blue(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Note (1) 0: Low Level Voltage, 1: High Level Voltage

## 6. INTERFACE TIMING

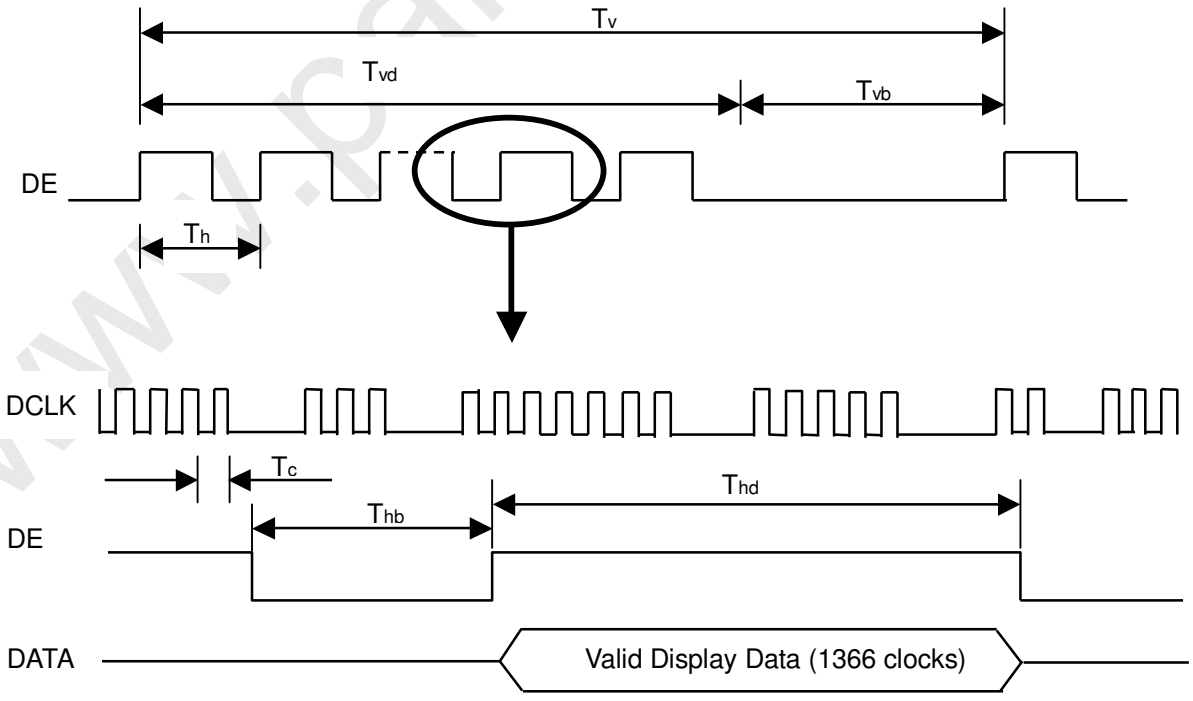
### 6.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

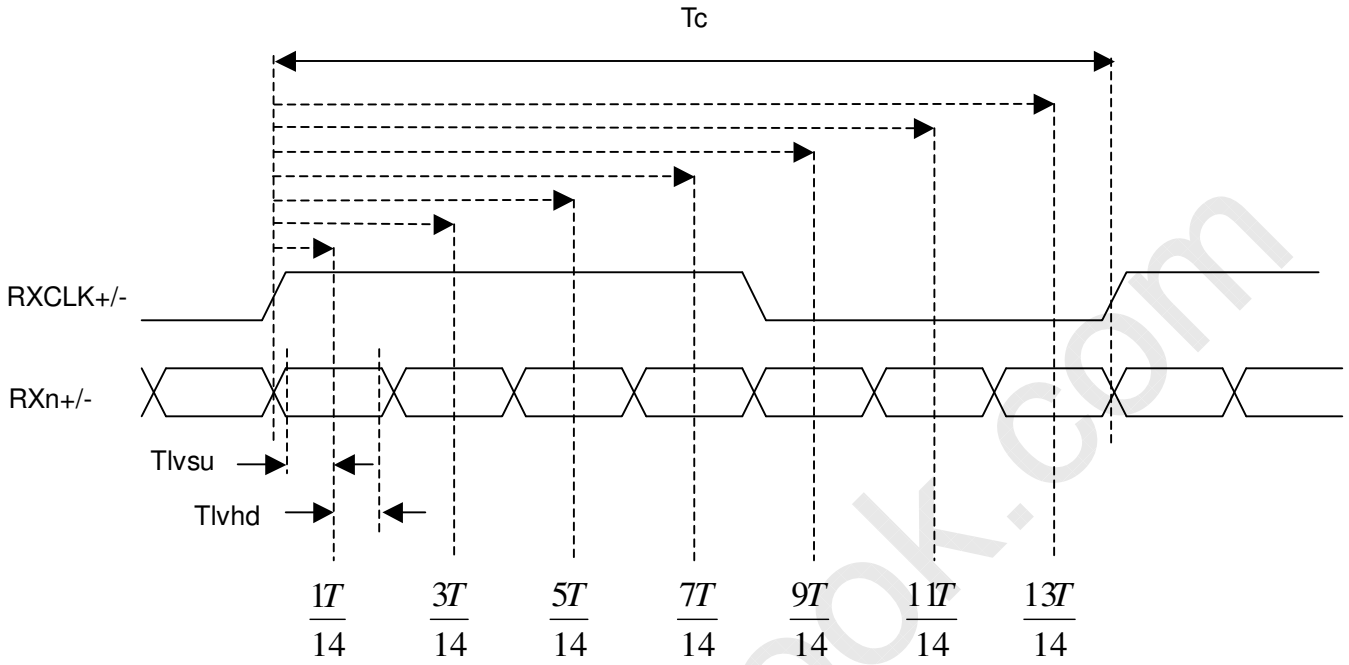
| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| LVDS Receiver Clock | Frequency | 1/Tc | 60 | 76 | 82 | MHz | |
| | Input cycle to cycle jitter | Trcl | — | — | 200 | ps | |
| LVDS Receiver Data | Setup Time | Tlvsu | 600 | — | — | ps | |
| | Hold Time | Tlvhd | 600 | — | — | ps | |
| Vertical Active Display Term | Frame Rate | Fr5 | 47 | 50 | 53 | Hz | |
| | | Fr6 | 57 | 60 | 63 | Hz | |
| | Total | Tv | 778 | 806 | 888 | Th | Tv=Tvd+Tvb |
| | Display | Tvd | 768 | 768 | 768 | Th | - |
| | Blank | Tvb | 10 | 38 | 120 | Th | - |
| Horizontal Active Display Term | Total | Th | 1442 | 1560 | 1936 | Tc | Th=Thd+Thb |
| | Display | Thd | 1366 | 1366 | 1366 | Tc | - |
| | Blank | Thb | 76 | 194 | 570 | Tc | - |

Note (1) Since this module is operated in DE only mode, Hsync and Vsync input signals should be set to low logic level. Otherwise, this module would operate abnormally.

**INPUT SIGNAL TIMING DIAGRAM**

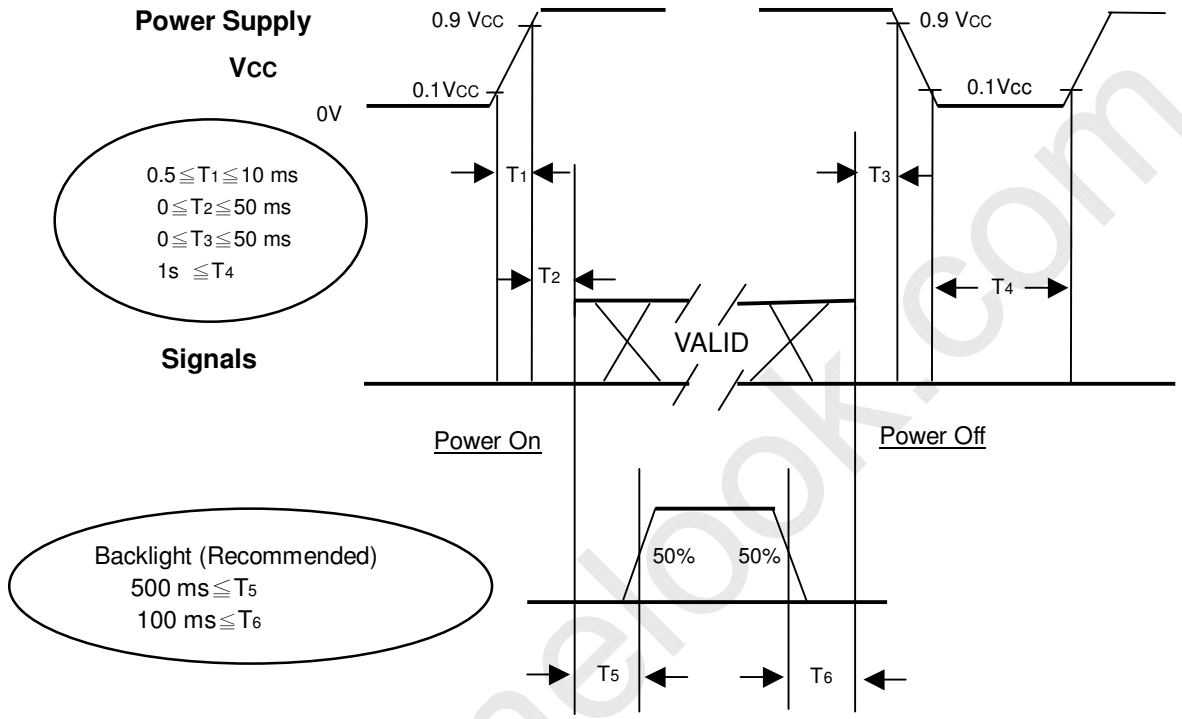


## LVDS RECEIVER INTERFACE TIMING DIAGRAM



### 6.2 POWER ON/OFF SEQUENCE

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should be as the diagram below.




**Power ON/OFF Sequence**

Note (1) The supply voltage of the external system for the module input should follow the definition of Vcc.

Note (2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

Note (3) In case of Vcc is in off level, please keep the level of input signals on the low or high impedance.

Note (4) T4 should be measured after the module has been fully discharged between power off and on period.

Note (5) Interface signal shall not be kept at high impedance when the power is on.

# 7. OPTICAL CHARACTERISTICS

## 7.1 TEST CONDITIONS

| Item | Symbol | Value | Unit |
|---|---|---|---|
| Ambient Temperature | Ta | 25±2 | °C |
| Ambient Humidity | Ha | 50±10 | %RH |
| Supply Voltage | $V_{CC}$ | 12.0 | V |
| Input Signal | According to typical value in "3. ELECTRICAL CHARACTERISTICS" | | |
| Lamp Current | $I_L$ | 5.0 ± 0.5 | mA |
| Oscillating Frequency (Inverter) | $F_W$ | 58 ± 3 | KHz |
| Vertical Frame Rate | Fr | 60 | Hz |

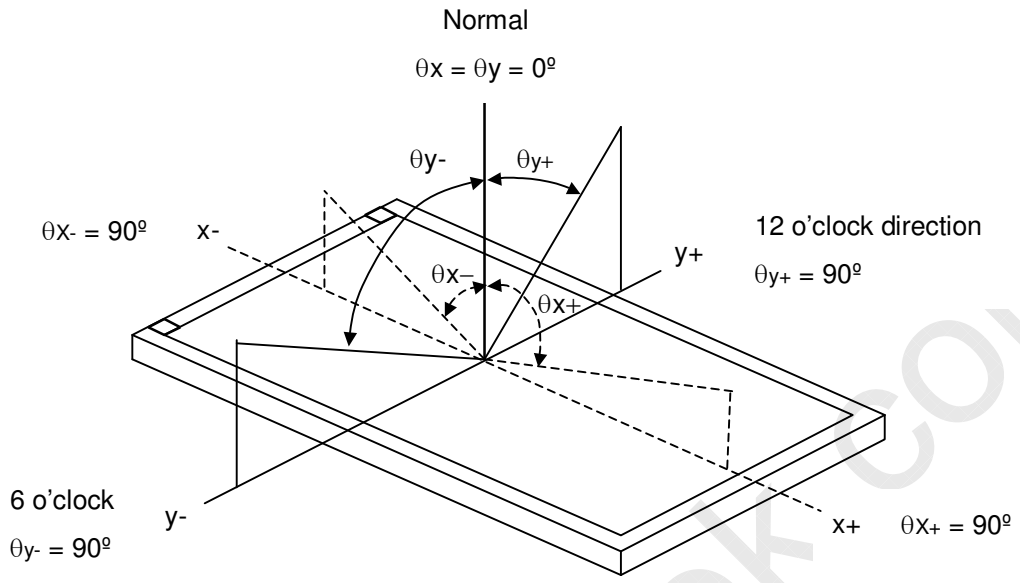
## 7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (6).

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio | | CR | $\theta_x$=0°, $\theta_Y$ =0° Viewing Angle at Normal Direction | | (800) | | - | (2) |
| Response Time | | $T_R$ | | | (3) | | ms | (3) |
| | | $T_F$ | | | (5) | | | |
| Center Luminance of White | | $L_C$ | | | (500) | | | (4) |
| White Variation | | δW | | | | (1.3) | - | (7) |
| Cross Talk | | CT | | | | (4) | % | (5) |
| Color Chromaticity | Red | Rx | | Typ. -0.03 | (0.634) | Typ. +0.03 | - | (6) |
| | | Ry | | | (0.331) | | - | |
| | Green | Gx | | | (0.266) | | - | |
| | | Gy | | | (0.595) | | - | |
| | Blue | Bx | | | (0.150) | | - | |
| | | By | | | (0.059) | | - | |
| | White | Wx | | | (0.280) | | Target | |
| | | Wy | | | (0.285) | | | |
| | Color Gamut | CG | | | (72) | | % | NTSC |
| Viewing Angle | Horizontal | $\theta_x$+ | CR≥10 | | (80) | | Deg. | (1) |
| | | $\theta_x$- | | | (80) | | | |
| | Vertical | $\theta_Y$+ | | | (80) | | | |
| | | $\theta_Y$- | | | (70) | | | |

Note (1) Definition of Viewing Angle (θx, θy):

Viewing angles are measured by EZ-Contrast 160R (Eldim)




Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

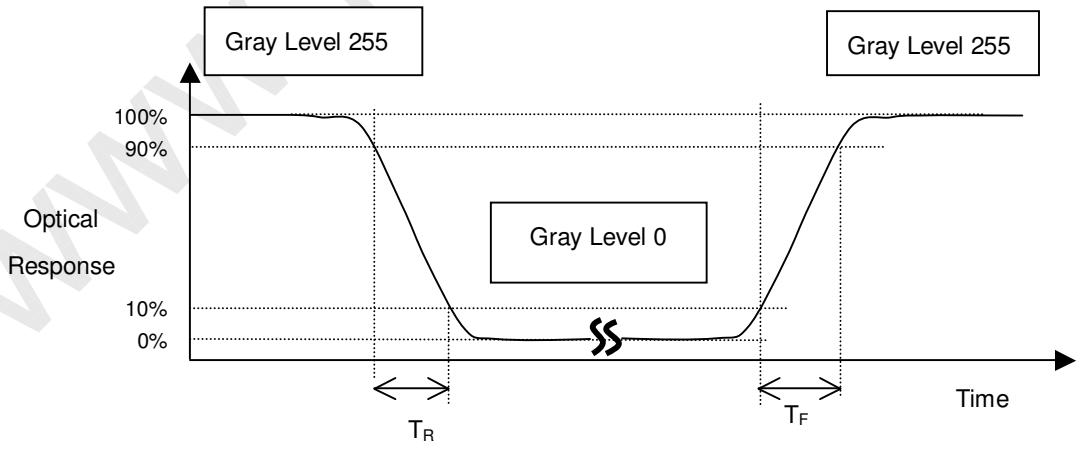
Contrast Ratio (CR) = L255 / L0

L255: Luminance of gray level 255

L 0: Luminance of gray level 0

CR = CR (5), where CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (7).

Note (3) Definition of Response Time ($T_R$, $T_F$):



Note (4) Definition of Luminance of White ($L_C$):

Measure the luminance of gray level 255 at center point and 5 points

$L_C$ = L (5), where L (X) is corresponding to the luminance of the point X at the figure in Note (7).

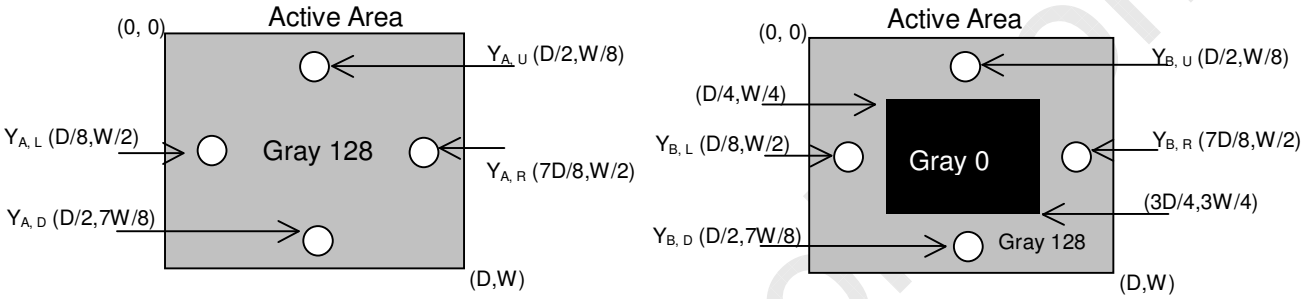
Note (5) Definition of Cross Talk (CT):

$CT = | Y_B - Y_A | / Y_A \times 100$ (%)

Where:

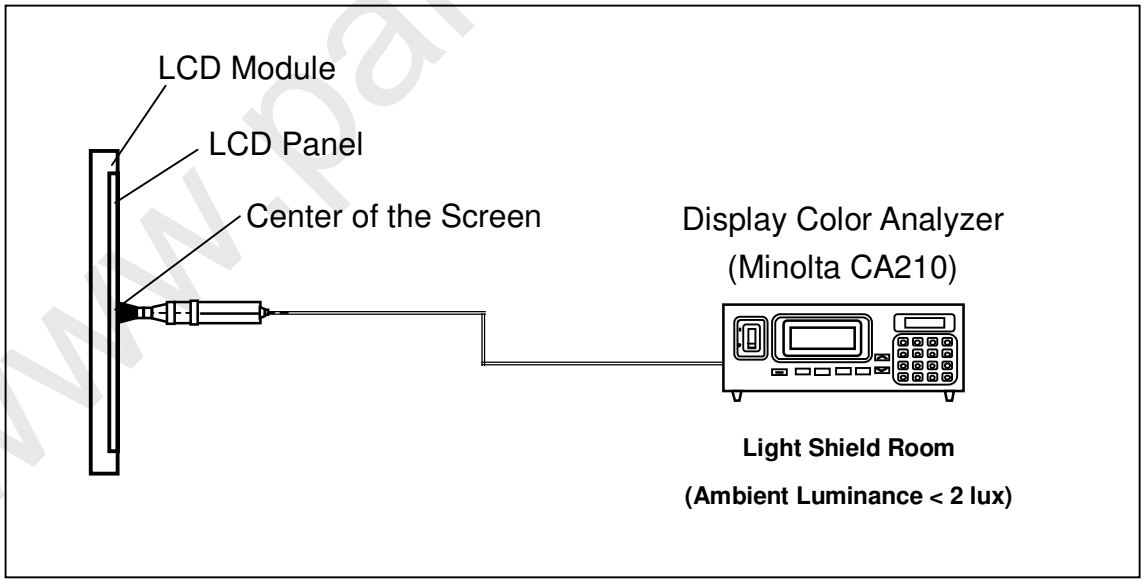
$Y_A$ = Luminance of measured location without gray level 0 pattern (cd/m$^2$)

$Y_B$ = Luminance of measured location with gray level 0 pattern (cd/m$^2$)




Note (6) Measurement Setup:

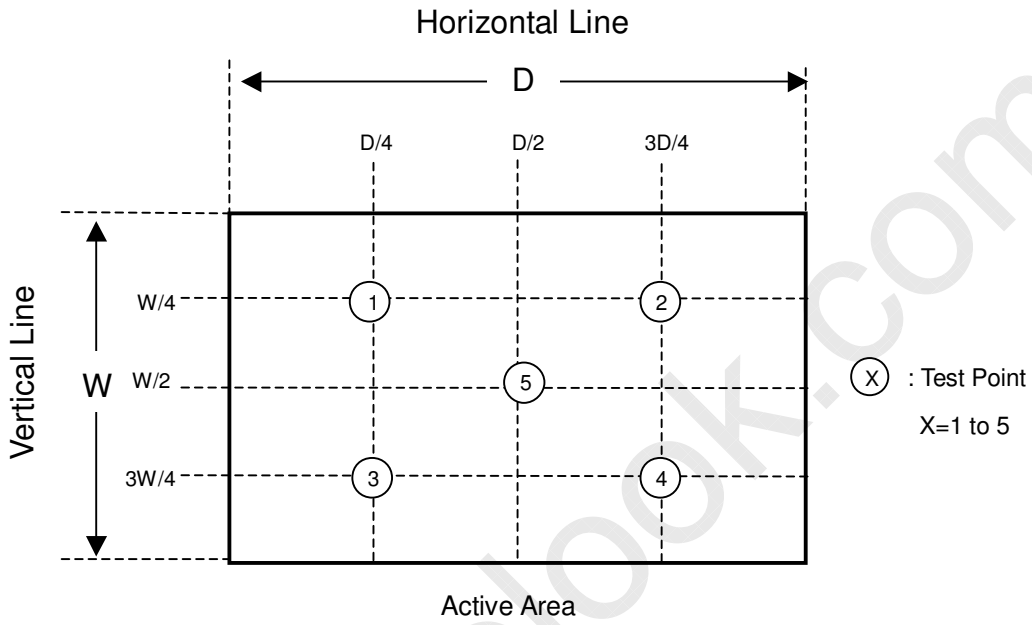
The LCD module should be stabilized at given temperature for 1 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 1 hour in a windless room.



Note (7) Definition of White Variation (δW):

Measure the luminance of gray level 255 at 5 points

δW = Maximum [L (1), L (2), L (3), L (4), L (5)] / Minimum [L (1), L (2), L (3), L (4), L (5)]



# 8. PRECAUTIONS

## 8.1 ASSEMBLY AND HANDLING PRECAUTIONS

(1) Do not apply rough force such as bending or twisting to the module during assembly.

(2) It is recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.

(3) Do not apply pressure or impulse to the module to prevent the damage of LCD panel and backlight.

(4) Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.

(5) Do not plug in or pull out the I/F connector while the module is in operation.

(6) Do not disassemble the module.

(7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.

(8) Moisture can easily penetrate into LCD module and may cause the damage during operation.

(9) High temperature or humidity may deteriorate the performance of LCD module. Please store LCD modules in the specified storage conditions.

(10) When ambient temperature is lower than 10ºC, the display quality might be reduced. For example, the response time will become slow, and the starting voltage of CCFL will be higher than that of room temperature.

## 8.2 SAFETY PRECAUTIONS

(1) The startup voltage of a backlight is over 1000 Volts. It may cause an electrical shock while assembling with the inverter. Do not disassemble the module or insert anything into the backlight unit.

(2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.

(3) After the module's end of life, it is not harmful in case of normal operation and storage.

## 8.3 STORAGE PRECAUTIONS

When storing modules as spares for a long time, the following precaution is necessary.

(1) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35℃ at normal humidity without condensation.

(2) The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.

## 9. MECHANICAL CHARACTERISTICS